REMARKS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 26-47 and 49 are pending in the present application. No claims are amended, canceled, or added by the present response.

In the outstanding Office Action, Claims 26-47 and 49 were rejected under 35 U.S.C. § 103(a) as unpatentable over Lu (U.S. Patent No. 5,773,839) in view of Nam (U.S. Patent No. 5,527,565), which is respectfully traversed for the following reasons.

Briefly recapitulating, independent Claim 26 is directed to a method of detecting radiation including, providing a layer of high purity single crystal CVD diamond having at least one of the (i)-(v) features, applying an electric field of no greater than 0.5 V/μm to the layer, exposing the layer to the radiation thereby generating a signal, and detecting the signal. The (i)-(v) features are: (i) in an off state, a resistivity R_1 is greater than 1×10^{12} Ω cm measured at an applied field of 50 V/μm and 300 K, (ii) a μτ product greater than 1.5×10^{-6} cm^2/V, measured at an applied field of 10 V/μm and 300 K, (iii) an electron mobility (μ_e) measured at 300 K greater than 2400 $cm^2V^{-1}s^{-1}$, (iv) a hole mobility (μ_h) measured at 300 K greater than 2100 $cm^2V^{-1}s^{-1}$, and (v) a high charge collection distance greater than 150 μm, measured at an applied field of 1 V/μm and 300 K. Independent Claim 47 recites similar features as Claim 26.

Turning to the applied art, Lu discloses a method of detecting radiation via a CVD diamond radiation detector that includes, among other things, a CVD diamond film with a collection distance of less than 1μm. However, the diamond in Lu is polycrystalline diamond and not single crystalline diamond as required by Claims 26 and 47. In addition, Lu does not teach or suggest that his method would be suitable for producing a single crystal diamond.

The outstanding Office Action asserts that Lu describes at column 2, line 6 and at column 5, lines 46-59 that the diamond has a mobility of 4,000 cm^2/Vs. However, this reference to mobility is one of a combined mobility as will be explained next. The combined mobility is the sum of the electron mobility and the hole mobility. At the time that Lu was filed, the commonly accepted values for the electron and hole mobilities in diamond were about 2200 $cm^2V^{-1}s^{-1}$ and 1800 $cm^2V^{-1}s^{-1}$ respectively, giving a combined mobility of about 4000 $cm^2V^{-1}s^{-1}$. That Lu uses the combined mobility value can be seen by reference to an article by Pan et al., Journal of Applied Physics (mentioned by Lu at column 4, lines 33-35). On pages 1089-1092 of the article, the derivation of the mobility-lifetime product is given.

The diamond used in the method of Claim 26 and the detector of Claim 47 is characterized by either the electron mobility or the hole mobility and not by the combined mobility as in Lu. The Lu polycrystalline diamond is not a diamond of the type forming the subject of the pending claims and also Lu does not disclose features (iii) and (iv).

Further, Lu does not apply an electric field of 0.02 V/ μm in the context of radiation detection. The applied field described at column 2, line 7 of Lu is in the context of providing a combined mobility value and not in the context of using the Lu polycrystalline diamond as a radiation detector, which is contrary to Claim 26, in which the applied filed is for detecting radiation.

Furthermore, the applied field of 0.02 V/ μm in Lu appears to not be accurate for the following reasons. Lu discloses a diamond in column 2, lines 5 to 8 with the following properties:

- Charge collection distance (CCD) of 15 μm (15×10^{-4} cm),
- Combined electron and hole mobility (μ) of 4000 $cm^2V^{-1}s^{-1}$,
- Carrier lifetime (τ) of 150 ps (150×10^{-12}s),
- Measured at an applied field (E) of 200 Vcm^{-1}.

Lu states in column 1, lines 63-66, that CCD = $\mu \tau E$. Using the values of μ, τ and E given in column 2, lines 5 to 8, the CCD obtained is: CCD = 4000 x 150 x10^{-12} x 200 = 1.2 x 10^{-4} cm = 1.2μm, which is different from the value stated above. Thus, the applied electric field value of 0.02 Vμm^{-1} in Lu is incorrect.

In addition, Applicants consider that the charge collection distance of the Lu polycrystalline diamond will saturate at the same level as other known polycrystalline diamond, namely at an applied field of about 1 V/ μm. This value is much higher than the claimed threshold.

The outstanding Office Action relies on Nam to show the use of polycrystalline and single crystal diamond in a detector. A combination of Nam with Lu can, at best, replace the polycrystalline diamond of Nam with the polycrystalline diamond of Lu but would not cure the deficiencies discussed above with regard to Claim 26.

Thus, Applicants respectfully submit that the combination of Lu and Nam does not teach or suggest a detector with a high charge collection efficiency at low applied electric fields, contrary to all the other diamond detectors, which at the effective filing date of this application, including those of Lu and Nam, required a much higher field of about 1 V/ μm or higher to reach saturation charge collection efficiency. As a result of the present invention, a detector is thinner and can be operated at lower voltages.

Accordingly, it is respectfully submitted that independent Claims 26 and 47 and each of the claims depending therefrom patentably distinguish over Lu and Nam, either alone or in combination.

Consequently, in light of the above discussion, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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